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Review

The visual analogue scale: Its use in pain measurement

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Summary. Use of pain rating scales, especially the visual analogue scale (VAS), has increased dramatically in the last decade. Consideration of the VAS in terms of its physical structure and the patient's behaviour when confronted with the scale, casts doubt on its validity. It is non-linear and prone to bias which limits its use as a serial measure of pain severity. Measuring pain intensity alone imposes further limitations. The McGill Pain Questionnaire measuring several dimensions of pain appears to be a better alternative.

Key words: Visual analogue scale – Pain measurement

Introduction

An exact and reliable measurement of pain would enable drug efficacy and patient progress to be accurately assessed. The visual analogue scale (VAS) has been widely used for this purpose in rheumatology [1] and is considered to be a robust, sensitive and reproducible method of expressing pain severity [2]. In addition, it takes relatively little time to complete and allows cross cultural comparisons due to minimal language translation difficulties. A common assumption made when using the VAS is that it provides a linear measure of pain [3]. This article reviews relevant literature on the VAS and provides evidence to suggest that the interaction between the behavioural tendencies of patients and the physical characteristics of the scale causes it to be non-linear and prone to response bias.

The visual analogue scale

The VAS provides a continuous scale for subjective magnitude estimation and consists of a straight line, the limits of which carry a verbal description of each extreme of the symptom to be evaluated. The line is usually 10 cm long and vertical [4], though different lengths and orientations have been employed and proven satisfactory [3, 5]. Inaccuracies resulting from poor reproduction during mass photocopying have been noted [4]. The VAS is often used to evaluate the analgesic properties of various treatments and accomplishes this by measuring either pain relief or pain severity. The stimultaneous measurement of both has been suggested [4] but is rarely observed.

The visual analogue pain relief scale (VAPRS)

The extreme limits of this "comparative" scale are defined in terms of pain relief, with "complete relief" entered at the lower end and "no relief" at the upper end. Following treatment, patients are required to place a mark on the line between the two extremes indicating their degree of pain relief. Pain relief scores are calculated by taking either the distance between the mark and the upper end of the scale or placing a linear graduated scale, usually divided into 20 equal parts numbered consecutively from 1 to 20, alongside the VAPRS and recording the pain relief score as the number corresponding to the patients mark.

The VAPRS is considered to have two main advantages [2, 4]. First, the magnitude of the response does not depend on the initial pain severity as all patients start from the same baseline, and second, there is no need to assume that the scale is linear. However, the disadvantages of this scale far outweigh its advantages. In measuring pain relief, the scale does not afford patients the opportunity to record an increase in pain, thereby creating a bias in favour of the treatment. The pain relief scale gives the false impression that all patients begin treatment with similar degrees of pain severity and masks real differences between patients. Recording the initial pain severity is important so that comparisons between patients may be made. In addition, the reliability of this scale is low owing to the patients' need to recall their initial pain severity before giving an estimate of their pain relief.

The visual analogue pain severity scale (VAPSS)

The extreme limits of this "absolute" scale are defined in terms of pain severity. "No pain" is entered at the lower

end and "extreme pain", "unbearable pain" or "worst pain ever" at the upper end. "Severe pain" is also used but does not truely represent an upper extreme of pain and therefore defeats the purpose of the scale. The VAPSS, which is completed before and after treatment, requires patients to place a mark on the line between the two extremes to represent their pain severity. Pain severity scores are recorded in a manner similar to pain relief scores, except that the distance between the patient's mark and the lower end of the scale is measured, again usually with a 20 point scale. Previous work on experimental pain indicates that subjects can distinguish 21 just noticeable differences in pain from when it is first perceived until it becomes intolerable [6]. Changes in pain are estimated indirectly by taking the difference between any two recordings of pain severity.

The VAPSS has several advantages over the VAPRS. First, it allows patients to indicate an increase or decrease in pain, and second, patients do not have to rely on their memory of pain to the same degree as required for the pain relief scale [7]. A major disadvantage is that the estimation of change in pain introduces a double measurement error [2, 7]. In addition, a relationship will always exist between change in pain and the initial pain severity score [2, 4, 8]. Consequently, an imbalance between initial pain severity scores in any two groups of patients studied might lead to a significant difference in the degree of change in pain observed [4]. This difficulty may be overcome using groups carefully matched for initial pain severity scores and then randomly allocated to different therapies.

A recent study comparing the two scales concluded that the VAPSS was less prone to bias than the VAPRS, and therefore preferable for general clinical use [7]. The remainder of the article will discuss the VAPSS only.

Physical characteristics of the VAPSS

The intrinsic physical characteristics of the VAPSS might markedly affect the accuracy of the scale during serial estimates of pain severity. The extremes of the VAPSS, which limit the range of response, are obvious examples and the position of the initial pain severity score (IPSS) within the scale range another. The lower endpoint of the VAPSS, i.e. "no pain", though finite, is influenced by the patients pain threshold and requires the difficult distinction between unpleasant sensation and pain to be made. The upper endpoint, i.e. "worst pain ever", is infinite because patients might always feel more pain than they previously considered to be their worst and as such this end point should theoretically never be reached. This creates a dilemma for those who mark their pain as worst ever, then feel more pain. These patients are forced to mark "worst pain ever" again, which will be recorded as "no change" when a real change has occurred. Even for patients who avoid marking "worst pain ever", this upper endpoint will produce a cramming or "ceiling" effect as their pain

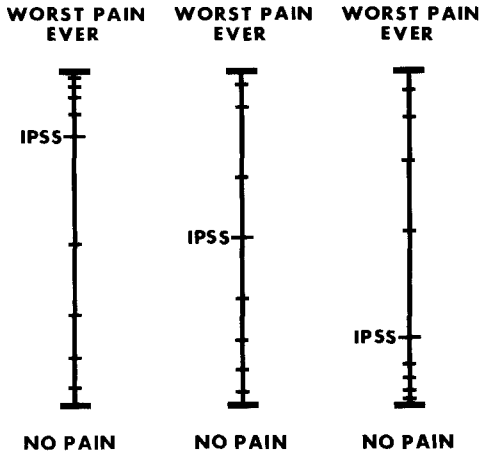

Fig. 1. A diagramatic representation of the influence of the position of the initial pain severity score (*IPSS*) upon further pain severity scores

severity approaches it. The linearity of the VAPSS is affected by the position of patients' initial pain severity scores (IPSS) within the scale range (Fig. 1). An IPSS in the middle of the scale range allows values to be selected on either side of it, but when the IPSS is at an extreme end of the scale, only one direction is available for remaining scores [9]. If the IPSS is at the lower end of the scale range, pain scores smaller than the IPSS (i.e. decreasing pain) will tend to be crammed ("flooring" effect) while estimates larger than the IPSS (i.e. increasing pain) will tend to be spread out. Conversely, if the IPSS is near the upper end of the scale range, pain scores larger than the IPSS (i.e. increasing pain) will tend to be crammed ("ceiling" effect) while estimates smaller than the IPSS (i.e. decreasing pain) will tend to be spread out. Consequently, the VAPSS should not be considered as linear, rather more logarithmic in nature.

In addition to the patients' behavioural tendencies when completing the VAPSS, their memory of previous pain recordings might influence the accuracy of serial measurements. This raises the question as to whether previous pain recordings should be made available before further pain estimates are attempted. In long-term studies (3 months to 3 years) this is considered essential however, in short-term studies (less than 2 weeks) patients remember their initial pain recordings quite accurately [10].

Discriminatory power of the VAPSS

The VAPSS is considered to be superior to other pain scales in its ability to detect relatively small changes in pain [4, 11, 12]. This is attributed incorrectly to the uniformity of patients responses and the unlimited number of choice response catagories available. Studies of experimental pain have shown that subjects tend to spread their pain estimates uniformly over a restricted response range regardless of the intensity, spacing and frequency of the underlying pain stimulus continuum [13, 14]. An

artificial uniformity in response distribution occurs which is insensitive to changes in pain and uninfluenced by the number of response categories available [15]. Nevertheless, the ability of the analogue scale to detect small changes in pain has been adequately demonstrated in analgesic drug withdrawal and efficacy studies [16, 17]. A recent study using a colour "graduated" VAPSS found it to be more discriminatory than the standard VAPSS, distinguishing 39 grades of pain as opposed to 21 [18]. The increased sensitivity was considered to be related to easier patient explanation and understanding and an improvement in visual perception. However, this modified VAPSS, like the standard scale, does not overcome the many problems associated with the upper and lower endpoints.

Comparison of the VAPSS and verbal rating scale (VRS)

The VRS consists of a set of word descriptors such as none, slight, mild, moderate, severe, extreme, and worst pain ever. Patients are required to select the word which best describes their pain severity. To allow a valid comparison between the VAPSS and VRS, both scales must provide similar extremes of pain severity, such as "no pain" and "worst pain ever". These endpoints are "fixed", in that any individual who marks "no pain" or "worst pain ever" on the VAPSS, must also choose the corresponding category of the VRS. A recent study [19] comparing the VAPSS and VRS and using similar limits of pain severity, concluded that a sigmoidal relationship existed between the two scales (Fig. 2). This suggests that pain scores in the middle

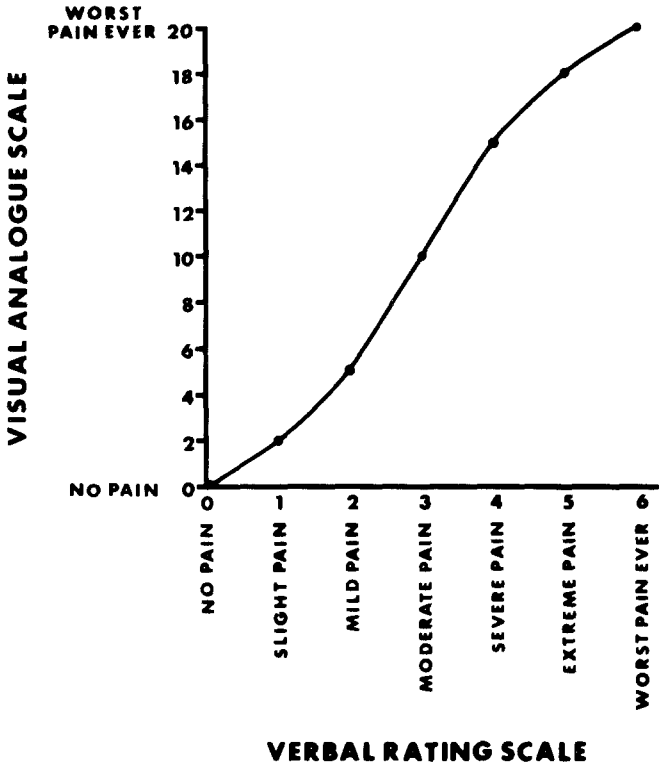

Fig. 2. The sigmoidal relationship between visual analogue and verbal pain rating scales (taken from [19])

of the scales are linearly related, but not those at the upper and lower extremities. Other studies comparing the VAPSS and VRS and using different scale endpoints have demonstrated linear relationships [20, 21]. Such relationships found between two subjective pain measurement scales neither validates them nor gives any information about their individual physical characteristics.

A major criticism of visual analogue and verbal pain rating scales is their inability to measure aspects of pain other than intensity. It is well recognized that pain is a diverse experience influenced by many factors including personality, past memories of painful events, emotion and culture. As qualities of pain are commonly expressed using words, Melzack and Torgerson [22] have produced a multidimensional pain descriptor scale called the McGill Pain Questionnaire. This consists of three major classes of word descriptors summarizing sensory qualities, affective qualities and evaluative qualities. Additional measures of temporal characteristics, pain intensity and localization are included. The McGill Pain Questionnaire has been used to quantify clinical pain and measure the relative efficacy of pain control methods. It has been found to be a sensitive, reliable and discriminative instrument of considerable diagnostic power [23, 24]. In patients with arthritis it appears to be a useful instrument for describing their pain [25]. Not unexpectedly, poor correlations were found between scores derived from the McGill Pain Questionnaire and these derived from either the VAPSS or VRS [26].

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